



US005983230A

United States Patent [19]

Gilbert et al.

[11] Patent Number: 5,983,230
[45] Date of Patent: Nov. 9, 1999

- [54] **ORDERED SPARSE ACCUMULATOR AND ITS USE IN EFFICIENT SPARSE MATRIX COMPUTATION**
- [75] Inventors: **John R. Gilbert**, Palo Alto, Calif.;
William W. Pugh, Jr., Silver Spring;
Tatiana Shpeisman, Adelphi, both of Md.
- [73] Assignee: **Xerox Corporation**, Stamford, Conn.
- [21] Appl. No.: 08/573,708
- [22] Filed: Dec. 18, 1995
- [51] Int. Cl.⁶ G06F 17/00
- [52] U.S. Cl. 707/101; 395/707; 395/708;
364/736.03
- [58] Field of Search 395/601-602,
395/607-612, 621-622, 570-708; 364/800.11-800.16,
725.01-754.02; 707/1-206

[56] References Cited

U.S. PATENT DOCUMENTS

4,787,057	11/1988	Hammond	364/754
5,392,429	2/1995	Agrawal et al.	395/650
5,557,710	9/1996	Amdursky et al.	395/119

OTHER PUBLICATIONS

<http://sandbox.parc.xerox.com/gilbert>.
<http://www.cscfi/Mail/NANET/msg00066.html>, Jan. 28, 1994.

Gilbert et al., "Sparse Matrices In MATLAB: Design and Implementation," SIAM Journal on Matrix Analysis and Applications, pp. 333-357, Jan. 1992.

Aho, A.V.; Hopcroft, J.E.; and Ullman, J.D. "The Design and Analysis of Computer Algorithms." Addison-Wesley Series in Computer Science and Information Processing, Oct. 1975, © 1974, pp. 87-92, 146, 166-167.

Demmel, J.W.; Eisenstat, S.C.; Gilbert, J.R.; Li, X.S. and Liu, J.W.H. "A Supernodal Approach to Sparse Partial Pivoting." CSL-P95-3, Sep. 1995, [P95-00313], © 1995 Xerox Corporation.

Gilbert, J.R. and Peierls, T. "Sparse Partial Pivoting in Time Proportional to Arithmetic Operations." SIAM J. SCI. STAT. COMPUT., vol. 9, No. 5, Sep. 1988, pp. 862-874.

Pugh, W. "Skip Lists: A Probabilistic Alternative To Balanced Trees." Communications of the ACM, Jun. 1990, vol. 33, No. 6, pp. 668-676.

Tarjan, R.E. "Data Structures and Network Algorithms." Society for Industrial and Applied Mathematics, 1983, pp. 33-43, 48-53.

Primary Examiner—Wayne Amsbury
Assistant Examiner—David Yink Jung

[57] ABSTRACT

A data structure, called an ordered sparse accumulator (Ordered SPA), permits sequencing in numeric order by index and dynamic alteration of the nonzero structure of the active column in sparse matrix computations during the sequencing operation.

5 Claims, 5 Drawing Sheets

